Bullen

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Dr.Joshua Lederberg
Department of Genetics
Stanford University Medical Center
Palo Alto - California

Dear Dr.Lederberg,

Forgive my answering your letter by return mail which I rarely ever do, but since we are leaving to return home in a few weeks I might never get to it otherwise.

My interest in the orientation of cells stemmed from an attempt to find a non-destructive method for separating ribosomes and it seemed that there might be a sufficient induced dipole moment. It turns out that this is probably not so, but in starting to work I made some explorations with whole bacterial cells (E.coli).

Whole cells do indeed have a large inducible dipole moment and will orient in A.C.fields up to several megacydes. In my experience it was necessary to use well washed cells suspended in water of low conductivity. Addition of small amounts of salt or even poor grade distilled water wiped out the effect. As I remember it, even washed TCA precipitated cells would orient, so the state of the cells is not too important.

The effect can be most easily observed under a microscope between parallel small wires. The cells completely orient at low fields and then form chains along the lines of force (like iron filings in a magnetic field). In the strongly inhomogenous fields near a sharp point the cells will move quite rapidly and be effectively collected.

This observation led me to suggest the method to the people at Camp Detrick and they may have explored it further. I don't remember the names but if you are still interested I might try to put you in touch with them on my return.

I know of no respectable publications and did not publish myself since I lost interest before getting any evidence on the mechanism.

The effect of very dilute salts suggests that surface charges are involved but might also be interpreted in terms of a low internal conductivity. This question could probably be resolved by increasing the external conductivity with a non-penetrating polyelectrolyte. According to the second picture the dipole moment would disappear when the conductivity was matched and reappear again at excess external conductivity, giving by the way, a measure of the cell's effective conductivity.

I also made a few measurements of the degree of orientation by means of light scattered at 45°. Measuring the field strength for a given degree of orientation, it looked as if there was a critical frequency corresponding to objects the size of ribosomes but this could have been due to monkey-business in signal generator etc. From my point of view it did not appear that it would pay to put time in beyond a quick exploration so I gave it up completely.

I hope this may be of some help to you and your graduate student.

Sincerely yours,

Roy Britten